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The Role of Patents in the International Framework of Clean Technology Transfer: A Discussion of Barriers and Solutions

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I. Introduction

Alarming average temperature increases of the Earth's surface and oceans have prompted global action to curtail the human population's impact on climate change.[1] Increases in global temperatures will significantly impact water resources, food security, coastal regions, biological ecosystems, and human health.[2] Climate fluctuations will likely increase the frequency and intensity of extreme weather phenomenon such as severe storms, floods, and droughts.[3] Weather and regional temperature changes could harm agricultural land and ecosystems, spread disease, and irreparably damage health and food security in many regions throughout the world.[4] Predictions also foretell of irreversible ice cap melting, the sea level rising, and mass flooding of coastal regions – displacing portions of the human population.[5]

Strong scientific evidence has determined that human production of "greenhouse gases" are the primary culprit in trapping heat, leading to global warming over the last half century.[6] Greenhouse gases in the atmosphere like carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) absorb, scatter, and emit energy that would otherwise be radiated into space, resulting in a net warming of the Earth.[7] The large quantities of greenhouse gases emitted during human energy production, e.g., by burning coal or oil, have exacerbated this phenomenon beyond its natural degree, despite being a normal and partially necessary process to keep the Earth habitable.[8] Anthropogenic warming over the last three decades has likely had a global influence on many physical and biological systems.[9] In response, scientists and engineers have developed "clean" technologies to significantly decrease greenhouse gas emissions. Clean technologies are designed to mitigate climate change with solutions ranging from carbon capture and energy-efficient devices to renewable energy sources and hybrid technologies.

In addition to environmental concerns, the world's governments have recognized that its current *modus operandi* of energy production is not sustainable.[10] The world's energy production, largely based on fossil fuels, will inevitably come to an end as the supply of those fuels dwindles. Spawned by the gas shortage of the 1970s and reinforced by the oil price spikes of the past decade, concerns over our dependence on fossil fuels has driven scientists, economists, and politicians to call for a transition to sustainable forms of energy production.[11] Sustainable or "renewable" energy sources include mainly solar, wind, hydro/marine, geothermal, and biomass. Renewable energy technologies are designed to harness and convert these naturally occurring forms of energy into electricity and other usable forms of power. These clean technologies have the benefit of being based on virtually limitless resources while significantly reducing environmental impact with minimal production of greenhouse gases. In addition to renewable energy technologies, adaptation and mitigation technologies can help minimize the impact from greenhouse gases generated by traditional forms of energy generation. Though mitigation and adaptation technologies are unable to prevent all climate change, they can substantially reduce the rate and magnitude of such

1. *See* Intergovernmental Panel on Climate Change [IPCC] Plenary XXVII, Climate Change 2007: Synthesis Report (November 2007) [hereinafter IPCC Plenary XXVII].

2. *See id.* at 51.

3. *See id.* at 53.

4. *See id.* at 48-53. "Sea level rise is expected to exacerbate inundation, storm surge, erosion and other coastal hazards, thus threatening vital infrastructure, settlements and facilities that support the livelihood of island communities." *Id.* at 52. "Increased risk of extreme high sea level" is predicted to be likely causing and "potential for movement of populations and infrastructure" and "migration-related health effects." *Id.* at 53.

5. *See id*.

6. *Id.* at 39.

7. *See id.* at 36-37 ("The atmospheric concentrations of CO_2 and CH_4 in 2005 exceed by far the natural range over the last 650,000 years. Global increases in CO_2 concentrations are due primarily to fossil fuel use, with land-use change providing another significant but smaller contribution. It is very likely that the observed increase in CH_4 concentration is predominantly due to agriculture and fossil fuel use. The increase in N_2O concentration is primarily due to agriculture.").

8. *Id.*

9. *Id.* at 41.

10. *See generally* Energy Independence and Security Act of 2007, Pub. L. No. 110-140, 121 Stat. 1492 (2007) (intending to increase the production of clean renewable fuels, to increase the efficiency, to promote research on and deploy greenhouse gas capture); Council Directive 2009/28, 2009 O.J. (L140) (EC) (promoting of the use of energy from renewable sources in the European Union).

11. *Id.*; *See also* Daniel Kammen, *Renewable Energy in U.S. Foreign Policy*, 36 Golden Gate U. L. Rev. 327 (2006).

change.[12] All of these clean technology solutions are an essential component in combating climate change.[13] Despite these advances and given current climate change mitigation policies and sustainable development practices, global greenhouse gas emissions will continue to grow over the next few decades.[14]

First, this paper will address the current intergovernmental legal framework relating to climate change and the international transfer of climate change mitigation and adaptation technologies.[15] Second, the paper will discuss some of the perceived barriers and possible solutions surrounding international technology transfer. Finally, the paper suggests an optimal solution based on the current international framework and evidence of technology transfer barriers. A goal of this paper is to show that the global intellectual property regime should be part of a solution and not a barrier to international technology transfer.

II. United Nation Framework Convention on Climate Change

The 1992 United Nation Framework Convention on Climate Change (UNFCCC)[16] came into force in 1994 as a global initiative to stabilize greenhouse gas concentration in the atmosphere.[17] The UNFCCC has been ratified by countries representing almost all global producers of greenhouse gas emissions.[18] The stated objectives of the UNFCCC include: allowing the ecosystem to adapt, ensuring food production, and creating sustainable economic development.[19] The UNFCCC states that developed countries should bear the primary financial burden in achieving these objectives.[20]

> The developed country Parties and other developed Parties … shall take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and know-how to other Parties, particularly developing country Parties, to enable them to implement the provisions of the Convention.[21]

The U.N. Conference on Trade and Development describes the "transfer of technology" as the communication of "systematic knowledge for the manufacture of a product, for the application of a process or for the rendering of a service," which "does not extend to the transactions involving the mere sale or mere lease of goods."[22] The knowledge should include all of the "entrepreneurial expertise and professional know-how" needed to commercialize the technology.[23]

The third annual Conference of Parties (COP) of the UNFCCC adopted the Kyoto Protocol which, *inter alia*, set emission limits for the parties.[24] Subsequent to agreement on the Kyoto Protocol, the patent world saw a dramatic rise in the patenting of clean technologies.[25] This reaction suggests that further restrictions on carbon emissions would alter the clean technology landscape by increasing the demand for clean technologies, thereby driving innovation through the patent system.

In addition to emissions reduction goals, the UNFCCC has spawned a variety of technology transfer mechanisms. The Kyoto Protocol introduced

12. *Id.*at 65.

13. International Centre for Trade and Sustainable Development [ICTSD], Climate Change, Technology Transfer and Intellectual Property Rights: Background Paper 1 (August 2008) [hereinafter ICTSD Background Paper].

14. IPCC Plenary XXVII, *supra* note 1, at 44.

15. This transfer of clean technologies is traditionally viewed from the perspective of developed nations – whereby developed nations are seen as inventors of clean technologies and developing nations are seen as needing those inventions as their energy production increases. Some evidence presented in this paper contradicts this paradigm – particularly regarding emerging economies.

16. The leading international treaty establishing a Secretariat to consider what can be done to reduce global warming and to cope with whatever temperature increases are inevitable.

17. U.N. Framework Convention on Climate Change Art. 2, May 9, 1992, 1771 U.N.T.S. 107 [hereinafter UNFCCC].

18. *See Greenhouse Gas Inventory Data*, UNFCCC, http://ghg.unfccc.int/index.html (last visited Aug. 10, 2011) (containing data estimating the levels of greenhouse gas (GHG) emissions for members to the TRIPS Agreement); K.Ravi Srinivas, Climate *Change, Technology Transfer and Intellectual Property Rights* 30, Research and Information System for Developing Countries (2009).

19. *Id.*

20. UNFCCC, *supra* note 17, at Art. 3.1, 4.3.

21. UNFCCC, *supra* note 17, at Art. 4.5.

22. U.N. Conference on Trade and Development [UNCTAD], UNCTAD Series on Issues in International Investment Agreements 5-6 (2001), *available at* http://www.unctad.org/en/docs//psiteiitd28.en.pdf.

23. *See id.* (importing and reselling of a good in a particular country is not alone sufficient to constitute actual transfer of technology because it involves only the good and not the knowledge to create it.).

24. Kyoto Protocol to the United Nations Framework Convention on Climate Change , Conference of the Parties, 3d Session, U.N. Doc. FCCC/CP/1997/L.7/Add.1 (Dec. 11, 1997) [hereinafter Kyoto Protocol]; *See* United Nations Framework Convention on Climate Change, Conference of the Parties, Fifteenth Session, Dec. 7-19, 2009, Copenhagen, Den. U.N. Doc. FCCC/CP/2009/11/Add.1 (Mar. 30, 2010) [hereinafter COP-15].

25. U.N. Environment Programme, European Patent Office [EPO], and ICTSD, Patents and clean energy: bridging the gap between evidence and policy: Final report, 8 (2010) [hereinafter EPO report].

emissions trading, establishing a "carbon market" based on emission reduction units (ERUs).[26] In addition to trading ERUs, a clean development mechanism and joint implementation plan enables countries to meet their emissions reduction targets, stimulate sustainable development, and encourage contributions from developing countries and the private sector.[27] But developing countries view these mechanisms as inadequate to fulfill the UNFCCC commitments of developed nations.[28]

The Kyoto Protocol is set to expire in 2012 and efforts to continue or expand its emission restrictions have largely failed.[29] A deadline to settle on a new emissions framework was set for the fifteenth COP session in Copenhagen, Denmark in 2009, but negotiations did not produce an agreement.[30] The Copenhagen Accord did establish a Technology Mechanism "to accelerate technology development and transfer in support of action on adaptation and mitigation that will be guided by a country-driven approach and be based on national circumstances and priorities."[31] Many aspects of the Technology Mechanism are still unsettled, but countries might be more likely to agree on clean technology transfer mechanisms than on quantitative emissions reductions that might stimulate clean technology transfer.

III. Agreement on Trade-Related Aspects of Intellectual Property

The Agreement on Trade-Related Aspects of Intellectual Property (TRIPS Agreement) created minimum standards and a moderate amount of harmonization for intellectual property (IP) laws across the globe.[32] The treaty ensures that the intellectual property rights (IPRs) of each member state do not favor one nation over another or favor a nation's own citizens over foreign inventors.[33] These requirements promote facial neutrality of IP laws, but may not address the inherent imbalance of IP power between developed and developing nations.[34] This imbalance may be difficult to reconcile with the objectives and principles of the TRIPS Agreement. Article 7 of the TRIPS Agreement states that IPRs "should contribute … to the transfer and dissemination of technology" and Article 8 recommends "[a]ppropriate measures . . . to prevent the abuse of intellectual property rights by right holders or the resort to practices which . . . adversely affect the international transfer of technology."[35] In particular, Article 66.2 requires developed countries to provide incentives to their local enterprises and institutions to promote and encourage technology transfer to the least-developed countries (LDCs).[36] However, the degree of success of any technology transfer under the TRIPS Agreement is still unclear, and concerns are growing that mechanisms designed to encourage technology transfers to LDCs have been ineffective.[37]

Despite the specific provisions on technology transfer, the heart of the TRIPS Agreement is the protection of IPRs.[38] The underlying policy is based on the perspective that IPRs are fully protected as private commercial property and technology transfer is best achieved through competitive market conditions.[39] Thus, the treaty actually signifies a shift from emphasizing regulation of technology transfers in the interest of the developing country towards a more open market-based model. An open market-based model encourages technology transfer to developing countries through the operation of the free market, coupled with assistance and cooperation on the part of developed countries.[40]

IV. Intellectual Property Divide

How IPRs function in the technology transfer process has become increasingly important.[41] IPRs

26. Kyoto Protocol, *supra* note 24; *The Mechanisms under the Kyoto Protocol: Emissions Trading, the Clean Development Mechanism and Joint Implementation*, UNFCCC, http://unfccc.int/kyoto_protocol/mechanisms/items/1673.php (last visited Aug. 10, 2011) (detailing each mechanism). *See* Anita M. Halvorssen, *International Law And Sustainable Development -- Tools For Addressing Climate Change*, 39 Denv. J. Int'l L. & Pol'y 397, 416 (2011).

27. *Id.*

28. EPO report, *supra* note 25, at 19; Srinivas, *supra* note 18, at 1.

29. COP-15, *supra* note 24; Daniel Bodansky, *The Copenhagen Climate Change Conference: A Postmortem*, 104 Am. J. Int'l L. 230, 230 (2010). The Copenhagen Accord being only a political statement is devoid of legal force to replace or extend the Kyoto Protocol.

30. Bodansky, *supra* note 29.

31. COP-15, *supra* note 24.

32. TRIPS: Agreement on Trade-Related Aspects of Intellectual Property Rights, Apr. 15, 1994, Marrakesh Agreement Establishing the World Trade Organization, Annex 1C, THE LEGAL TEXTS: THE RESULTS OF THE URUGUAY ROUND OF MULTILATERAL TRADE NEGOTIATIONS 320 (1999), *1869 U.N.T.S. 299, 33 I.L.M. 1197 (1994) available at* http://www.wto.org/english/tratop_e/trips_e/t_agm0_e.htm [hereinafter TRIPS Agreement].

33. *Id.* at arts. 3, 4.

34. Cynthia Cannady, *Issue Paper No. 25: Access to Climate Change Technology by Developing Countries*, ICTSD Programme on IPRs and Sustainable Development (2009).

35. TRIPS Agreement, *supra* note 32, at arts. 7, 8.2.

36. TRIPS Agreement, *supra* note 32, at art. 66.2.

37. ICTSD Background Paper, *supra* note 13, at 3.

38. UNCTAD Series on Issues in International Investment Agreements, *supra* note 22, at 63.

39. *Id.*

40. *Id.* at 63-64.

41. EPO report, *supra* note 25, at 19.

are not expressly mentioned in the UNFCCC or the Kyoto Protocol, but prior to the UNFCCC COP-13 session held in Bali, several developing countries like Cuba, India, Indonesia, Tanzania, and China stressed the need to address the role of IP in the climate change discussion.[42] The subsequent Bali Action Plan suggests consideration of:

> Effective mechanisms and enhanced means for the removal of obstacles to, and provision of financial and other incentives for, scaling up of the development and transfer of technology to developing country Parties in order to promote access to affordable environmentally sound technologies.[43]

The UNFCCC parties disagree on whether IPRs are an obstacle that impede effective technology transfer and if so, what measures should be taken.[44] Developing countries, like China, have argued that patents are an obstacle to clean technology transfer because patents limit a country's access to clean technologies.[45] Conversely, the United States has expressly opposed any weakening of IPRs related to clean technologies.[46] The divide over IPRs has delayed agreement among UNFCCC parties concerning clean technology transfer.[47]

V. Patents and Technology Transfer

All IPRs, particularly patent rights, do not have equal potential to inhibit technology transfer across all developing nations.[48] Research by Copenhagen Economics suggests that patent filings in clean technology sectors are almost nonexistent in the least developed countries.[49] The research data showed that only 0.1 percent of the 215,000 patent applications for certain clean technologies were filed in LDCs.[50] If a particular technology is not patented in a particular country, anyone in that country can use the disclosed technology for its benefit. Therefore, patents are unlikely to be a barrier in LDCs.

However, countries with emerging economies have significant numbers of patents in clean technology sectors. One study showed that China ranked second among leading innovators in climate-friendly cement and geothermal energy.[51] The Republic of Korea ranked second for patents in energy-efficient lighting and Russia ranked third for patents in carbon-capture and storage, climate-friendly cement, and geothermal energy.[52] Other studies mentioned in a joint report by the European Patent Office, the U.N. Environment Programme, and the International Centre for Trade and Sustainable Development, have provided similar evidence that patents are important in many emerging economies and should be considered in the clean technology transfer debate as a possible barrier.[53] But the existence of significant quantities of patents in emerging economies does not resolve the issue of whether patents are a barrier to clean technology transfer.

Technical information is costly to learn and absorb for endogenous commercialization.[54] Technology owners with IPRs may theoretically demand prices that are higher than marginal cost or may monopolize markets.[55] The high concentration of equivalent clean technologies found in a small number of companies[56] increases the risk of anti-competitive behavior.[57] Anti-competitive practices are always a danger in intellectual property regimes and threaten to inhibit innovation in any market – developed or developing. Some corporations could engage in patent "blocking," a strategy whereby patent owners deter competitors from entering the market because of the costs associated with trying to invent in the neighborhood of patents.[58] However, the fungible nature of energy production and maturity of many

42. ICTSD Background Paper, *supra* note 13, at 4.

43. United Nations Framework Convention on Climate Change, Conference of the Parties, Thirteenth Session, Dec. 3-15, 2007; COP-13 in Bali, Indon. U.N. Doc. FCCC/CP/2007/6/Add.1 (Mar. 14, 2008).

44. ICTSD Background Paper, *supra* note 13, at 2.

45. Lisa Larrimore Ouellette, *Addressing the Green Patent Global Deadlock through Bayh-Dole Reform*, 119 Yale L.J. 1727, 1727 (2010).

46. *Id.* at 1728.

47. *Id.*

48. Copenhagen Econ. A/S & the IPR Co. ApS, *Are IPR a Barrier to the Transfer of Climate Change Technology?* (2009) (amassing research from several independent sources) [hereinafter Copenhagen Economics].

49. *Id.*

50. EPO report, *supra* note 25, at 22.

51. *Id.*

52. *Id.*

53. *Id.* at 22-23; Srinivas, *supra* note 18.

54. Keith E. Maskus, *Issue Paper No. 7: Encouraging International Technology Transfer*, *in* UNCTAD -ICTSD Project on IPRs and Sustainable Development § 2.2(a) (2004).

55. *Id.* at § 2.2(c).

56. EPO report, *supra* note 25, at 64.

57. Frederick M. Abbott, *Issue Paper No. 24: Innovation and Technology Transfer to Address Climate Change: Lessons from the Global Debate on Intellectual Property and Public Health*, Intellectual Property and Sustainable Development Series, ICTSD Programme on IPRs and Sustainable Development § 3 (2009).

58. Benjamin K. Sovacool, *Placing a Glove on the Invisible Hand: How Intellectual Property Rights May Impede Innovation in Energy Research and Development (R&D)*, 18 Alb. L.J. Sci. & Tech. 381, 419-20.

clean technologies decrease the likelihood of a single blocking patent.[59] Even in the biofuel sector, where avoiding patented microorganisms may be difficult, licensing of those patents is likely and royalties would not remain high for long.[60] Other factors, such as lack of capital and know-how, may be larger impediments to technology transfer.[61]

VI. The Search for Balance

Though true technology transfer is not necessarily based on IPRs, IPRs have the potential to make technology transfer too costly and impractical with almost any innovation. Most developing countries remain net consumers rather than donors of technology.[62] Developing countries have a strong interest in expanding their access to international technologies.[63] But not all developing countries have the same ability to learn from foreign technologies and absorb them into their domestic economy.[64] Emerging economies like China and Brazil have good investment potential and are likely to continue to gain technology through transfer to endogenous companies.[65] LDCs, on the other hand, may find little foreign direct investment without improvements to skill levels, infrastructure, IP protection/enforcement, and increases in funding for transfers.[66] At the international level, discussions to weaken IPRs have been recently proposed. During the UNFCCC Ad Hoc Working Group on Long-Term Cooperative Action session in June of 2009, parties included provisions specifically addressing IPRs in the negotiating text: compulsory licensing for patented environmentally-sound technologies, mandatory exclusions from patenting for climate-friendly technologies held by developed countries, pooling and sharing of publicly funded technologies, and making the technologies available in the public domain at an affordable price or royalty-free.[67] None of these provisions were ultimately adopted, but they are an insight into the current discussion of IPRs in the climate change context.

VII. Exclusions from Patentability

Patenting exclusions for clean technologies may be the most unlikely proposal to be adopted of all the ad hoc working group's proposals leading up to the COP-15 in Copenhagen. The provision allows countries to exclude applications for clean technology from patents and rescind patented clean technologies from patent protection.[68] This rather extreme solution seems to directly conflict a provision of the TRIPS Agreement. Article 27.1 of the TRIPS Agreement does not permit member states to exclude any field of technology as a whole from patentability.[69] However, the TRIPS Agreement does include certain "flexibilities" such as Articles 27.2 and 30. Under Article 30:

> Members may provide limited exceptions to the exclusive rights conferred by a patent, provided that such exceptions do not unreasonably conflict with a normal exploitation of the patent and do not unreasonably prejudice the legitimate interests of the patent owner, taking account of the legitimate interests of third parties.[70]

A member country could argue that clean technologies are a limited exception, but this idea may be very difficult to sell to a WTO dispute settlement panel. This exception has primarily been used to allow for academic research or experimental use by parties other than a patent holder.[71] A more narrowly-tailored exception, such as an exception to a particular clean technology sector, might have a better chance under Article 30. An exclusion of clean technology patents under Article 27.2 of the TRIPS Agreement also appears unlikely. It states:

> Members may exclude from patentability inventions, the prevention within their territory of the commercial exploitation of which

59. Abbott, *supra* note 57, at § 3.

60. John H. Barton, *Issue Paper No. 2: Intellectual Property and Access to Clean Energy Technologies in Developing Countries: An Analysis of Solar Photovoltaic, Biofuel and Wind Technologies,* ICTSD Programme on Trade and Environment (2007).

61. *See* Marilyn Brown et al., *U.S. Dep't of Energy, Carbon Lock-In: Barriers To Deploying Climate change Mitigation Technologies* (2007) (discussing barriers for U.S. companies) [hereinafter *Carbon Lock-In*].

62. UNCTAD Series on Issues in International Investment Agreements, *supra* note 22, at 7.

63. Maskus, *supra* note 54.

64. *Id.*

65. *See id.*

66. Whether this deficiency is real or just perceived in all sectors remains unclear and warrants further study. *See, e.g., Carbon Lock-in*, *supra* note 61.

67. U.N. Framework Convention on Climate Change, Ad Hoc Working Group on Long-Term Coop. Action Under the Convention, Bonn F.R.G., June 1-12, 2009, Negotiating Text, pp. 184, U.N. doc. FCCC/AWGL/2009/8 (May 19, 2009), available at http://unfccc.int/resource/docs/2009/awglca6/eng/inf01.pdf [hereinafter Negotiating Text].

68. *Id.*

69. TRIPS Agreement, *supra* note 32, at art. 27.1

70. TRIPS Agreement, *supra* note 32, at art. 30.

71. *See, e.g.,* Panel Report, Canada – Patent Protections of Pharmaceutical Products, WT/DS114/R (Mar. 17, 2000).

> is necessary to protect *ordre public* or morality, including to protect human, animal or plant life or health or to avoid serious prejudice to the environment, provided that such exclusion is not made merely because the exploitation is prohibited by their law.[72]

It would be contradictory to argue that protecting health or avoiding serious prejudice to the environment would be furthered by the prevention of commercial exploitation of clean technologies, when clean technologies would be implemented precisely to protect health or avoid serious prejudice to the environment.

At least in theory, parties to both the UNFCCC and the TRIPS Agreement could agree to concurrently amend the TRIPS Agreement, or agree not to enforce it in this regard, permiting abolishment of IPRs in clean technology sectors, but the risk of modifying the TRIPS Agreement should not be taken lightly.[73] Given the breadth of clean technology sectors, the indefiniteness of what is encompassed by clean technology, and the current divisiveness on the issue, such a one-sided change seems far-fetched.[74] Beyond the express unwillingness of developed nations to weaken patent protections, the lack of IPRs in the clean technology sectors might discourage clean technology transfer and impose a new barrier.

VIII. Compulsory Licensing[75]

Along with the ad hoc working group's proposed negotiating language, some non-governmental organizations have advocated for compulsory licensing.[76] The recipient country would issue a compulsory license by removing any royalty fees that an IPR holder might desire to charge.[77] Instead of weakening IPRs across all clean technology sectors, a single invention could be licensed on its individual merits. Such a policy seeks to prevent anti-competitive practices of IPR holders like hoarding.[78] Compulsory licensing is available under Article 31 of the TRIPS Agreement[79] and has been used in the past, such as in the pharmaceutical context.[80]

However, the pharmaceutical sector is quite different from clean technology sectors. A patented pharmaceutical is likely to be the exclusive solution to a particular need. Since there are usually no market alternatives to a patented pharmaceutical, the IPRs holder is able to charge large royalty fees. Developing nations may not be able to afford the pharmaceutical, even if the country is in great need of it.

Market competition in the area of clean technologies also differs in several ways from competition in the pharmaceuticals industry. First, a study by John Barton demonstrates that a fair amount of competition exists in the studied clean technology sectors, keeping pricing to a minimum.[81] This competition exists across multiple alternative energy sectors.[82] Also, many of the fundamental clean technological solutions have long been off-patent.[83]

Second, though compulsory licensing is permitted under the TRIPS Agreement, other bilateral or multilateral agreements may restrict the licensing of clean technologies, except in cases of national emergency. Also, compulsory licensing could potentially create an economic backlash.[84] Therefore, compulsory licensing may not be desirable for every developing nation because of overarching consequences.

Finally, a license to a patented technology does not necessarily equate to a transfer of technology. Unlike a pharmaceutical patent, where disclosure of a chemical formula may be sufficient to produce the product, a clean technology patent may not disclose enough information to actually commercialize the technology.[85] Trade secrets or technical know-how might be required and would be beyond the disclosure of the patent. In the pharmaceutical sector, a chemical formula may be sufficient for a manufacturer in a developing nation to produce a drug, and a compulsory license might be sufficient knowledge to permit manufacture. But in clean technology sectors, the inventions may require more skill or knowledge to

72. TRIPS Agreement, *supra* note 32, at art. 27.2.

73. ICTSD Background Paper, *supra* note 13, at 7.

74. Abbott, *supra* note 57, at § 6(c).

75. A compulsory licensing is a license a government grants to someone other than the patent owner to produce the patented product or process without the consent of the patent owner.

76. EPO Report, *supra* note 25, at 14a.

77. ICTSD Background Paper, *supra* note 13, at 6.

78. UNCTAD Series on Issues in International Investment Agreements, *supra* note 22, at 38.

79. TRIPS Agreement, *supra* note 32, at art. 31; ICTSD-UNCTAD Capacity Building Project on IPRs and Sustainable Development, *Resource Book on TRIPS and Development: An authoritative and practical guide to the TRIPS Agreement*, at 461, *available at*: http://www.iprsonline.org/unctadictsd/ResourceBookIndex.htm (June 1, 2005) [hereinafter Book on TRIPS].

80. William W. Fisher III & Dr. Cyrill P. Rigamonti, Harvard Law School, *The South Africa AIDS Controversy A Case Study in Patent Law and Policy* 12-13 (2005), *available at* http://cyber.law.harvard.edu/people/tfisher/South%20Africa.pdf.

81. Barton, *supra* note 60.

82. *Id.*

83. *Id.* The term "off-patent" refers to technologies which have out-lived their patent terms.

84. Robert Fair, *Does Climate Change Justify Compulsory Licensing of Green Technology?*, 6 B.Y.U. Int'l L. & Mgmt. Rev. 21, 25 (2009).

85. Srinivas, *supra* note 18, at 16-17, 27.

produce.

For example, a solar photovoltaic (PV) cell might be protected by multiple patents and trade secrets. The particular compositions of the layers of a p-n junction might be patented, but the method of obtaining the desired precision engineering of those layers might be a trade secret. Without the ability to precisely produce those layers, the true efficiency gain of the cell might never be realized. Therefore, a compulsory license may be insufficient for actual transfer of the clean technology, since it would only disclose part of the technology.[86] Additional components, perhaps covered by other patents and possibly owned by other companies, may be necessary for implementation of the PV cell. A compulsory license to one component of the PV cell may not be useful without the other components. Finally, it should be noted that developing countries present other barriers that may be greater obstacles than IPRs. Absence of a sufficient technological infrastructure, an underdeveloped domestic industry and R&D base, or poor access to production materials will undermine any gains of the compulsory license.

IX. Patent Pools

Another proposed technology transfer mechanism involves patent pooling, the sharing of clean technology at "affordable prices" or possibly "royalty-free."[87] It is unclear from the Ad Hoc Working Group negotiating text whether this sharing of clean technology is voluntary or mandatory. If voluntary, it may be similar to the current Eco-Patent Commons.[88] The Eco-Patent Commons has made some in-roads into sharing technology, but the only significant incentive for a business to submit patents to the Commons is for a business to improve how the public perceives it. This incentive is not strong enough for inventors to share their best or complete technological advances.[89]

If submission to a patent pool were mandatory, disputes might arise over remuneration because of the inherent difficulty of assessing what might be "affordable," or assessing the worth of individual components of a device. For example, if the manufacture of a solar panel involved multiple patents with different assignees, would remuneration be split equally among the assignees or split according to some determined percentage of contribution?

Despite the problems associated with pooling patents, packaging IP rights together with the know-how to implement an invention may be necessary in the LDCs and in emerging economies. A portion of the negotiating text does address "associated trade secrets and know-how on environmentally sound technologies and enable them to be accessed."[90] Hence, the patent pooling provision actually has an advantage over compulsory licensing in that it is more closely linked to transfer of technology and not just circumvention of IPRs. Also, developing nations would gain a better sense of the total cost of manufacture with a decreased risk of some unknown element impeding commercialization.

X. A Proposed Solution

The role of IPRs in the climate change context is both complex and controversial. As noted above, clean technologies encompass a wide variety of technologies – each with unique market conditions.[91] While virtually all nations might agree that climate change is a serious problem, the views of individual nations on intellectual property and climate change diverge.[92] These divergent positions may be irreconcilable if each country does not see an economic benefit to compromise. The fear of global warming and the recognition of an unsustainable energy policy may not be compelling enough to evoke a change to the IP system at the international level.

A. Green Technology Packages

A successful mechanism to promote IP in developing countries will require a multi-level approach – technology packages and coordination on an international level, as well as incentives and removal of barriers at the national level. At the international level, the idea of new Patent Commons by the Japan Intellectual Property Association or "green technology packages"[93] by Honda show the kind of promise lacking

86. Additionally, PV cells supply direct current and require converters to switch to an alternating current to use the electricity from a home. Further, PV cells are dependent on direct sunlight and must be coupled to batteries or allow for connection to a traditional power grid during low light hours.

87. Negotiating Text, *supra* note 67.

88. The Eco-Patent Commons was launched by IBM, Nokia, Pitney Bowes and Sony in partnership with the World Business Council for Sustainable Development (WBCSD) and was founded on the commitment that anyone who wants to bring environmental benefits to market can use these patents to protect the environment and enable collaboration between businesses that foster new innovations. World Business Council for Sustainable Development (WBCSD), http://www.wbcsd.org (last visited Aug. 10, 2011).

89. Cannady, *supra* note 34, at 11 (addressing the limits of patent pools); *But see* Andrew Boynton, *Eco-Patent Commons: A Donation Approach Encouraging Innovation Within The Patent System*, 35 Wm. & Mary Envtl. L. & Pol'y Rev. 659, 676 (2011).

90. Negotiating Text, *supra* note 67.

91. *See infra* Part V.

92. *See infra* Part IV.

93. A "package" would comprise sets of patents,

from the earlier altruistic treaties bent on combating climate change.[94]

A green technology package can gather knowledge beyond the information contained in a patent's specification – knowledge which may be necessary for true technology transfer. A patent is granted to an inventor as an exclusive right, in exchange for the inventor's public disclosure of how to make or use the invention. U.S. patent law requires a written description of the invention sufficient to teach one of ordinary skill in the art of how to make or use the invention.[95] In practice, this public disclosure may not provide the necessary know-how to efficiently commercialize the invention. The ability to make a single product does not necessarily equate to the ability manufacture a sufficient quantity to be commercially viable. Also, a patent application is written for "one of ordinary skill in the art."[96] So those wishing to make or use the invention may need to gain substantial knowledge in the field of endeavor. Additionally, the patent examination process has no physical means of determining whether the disclosure is, in fact, adequate to make the invention [97] As a result, there is no guarantee that even one of ordinary skill in the art will have sufficient knowledge to make or use the invention.[98] Further, patent applications can be drawn to individual components or aspects of a product or process, and the law does not require that all elements be disclosed so long as the claimed invention is substantially useful.[99] Instead of protecting the entire invention under one patent, companies may protect different aspects of an invention as trade secrets or under separate patents. All this has the effect to decoupling the knowledge disclosed by a patent and the knowledge needed for transfer of technology.

As noted above with patent pools, green technology packages have a distinct advantage over compulsory licensing because they are able to provide the knowledge necessary to commercialize an invention. The green technology package can include additional knowledge beyond the scope of a patent, such as technical information, human resource plans, and skills training. The green technology package can group multiple patents together so that the potential licensee does not need to negotiate separate licenses. For example, a PV cell, converter, and battery might be grouped together under this green technology package. This grouping would alleviate the difficulty of shopping for each component, which may be a significant undertaking if the potential licensee is unfamiliar with the technology. Also, the potential licensee would be able to project a more accurate business model, since the package provides a one-stop shop.

Another advantage of green technology packages is that pricing can be easily compared to among packages. Newly patented technologies must still compete with older, off-patent technologies. A green technology package allows flexible pricing to adjust to the demand and position of each technology area. Wind, PV, and biofuel all have a small number of market members, but high levels of competition. Analysis shows that strong competition among wind, PV, and biofuel manufacturers has kept licensing prices down.[100] For example, a Chinese firm, Goldwind, licensed wind technology from a German firm for a 1% royalty.[101] Presumably a green technology package would also be competitively priced to attract developing nations.[102]

Based on an EPO licensing survey, there is little overall out-licensing to developing countries in clean technology sectors, which is on par with other industries.[103] This suggests that current clean technology transfer mechanisms have failed to appreciably promote out-licensing. One possible reason for the under-licensing is the failure of licensors to communicate with potential licensees. Based on the submissions by developing countries of their technology needs assessments (TNAs) to the Global Environment Facility (GEF), developing countries may not be aware of the technical solutions available throughout the world.[104] The EPO has added a new classification scheme to enhance global awareness of patented and non-patented solutions in clean technology sectors.[105] But perhaps there is an opportunity to match the needs of developing countries (identified by the TNAs) and the actual patent owners – or better yet green technology package owners.

documentation, and other IP and non-IP knowledge gathered together to facilitate commercialization.

94. Cannady, *supra* note 34, at 19.

95. 35 U.S.C. § 112 (2006).

96. *Id.*

97. For over a century the U.S. Patent and Trademark Office has not required a working model an invention to grant a patent.

98. Srinivas, *supra* note 18, at 26. However, a patent may be invalidated by a U.S. federal court on the grounds practicing the invention requires knowledge beyond the level of one of ordinary skill in the art.

99. *See* 35 U.S.C. § 101 (2006).

100. Barton, *supra* note 60, at 4.

101. *Id.* (Wind, having the lowest competition of the three sectors, would normally have the highest royalties).

102. Developing countries may also be able to draw from public funds.

103. EPO Report, *supra* note 25, at 64.

104. Handbook for Conducting Technology Needs Assessment for Climate Change 20, 21 (Sarwat Chowdhury et al. eds., 2010) (directing countries implementing a technology needs assessment to ClimateTechWiki designed to inform them about different technology options).

105. EPO Report, *supra* note 25, at 65.

A recent draft by the Expert Group on Technology Transfer concerning the Technology Mechanism of the Copenhagen Accord envisions a Climate Technology Centre (CTC) that would function as network hub and facilitator, technical advisor and consultant, matchmaker, catalyst, broker, and technology accelerator.[106] A body such as the CTC might be used to link a demand in developing nations for a particular clean technology to a provider of such technology, bridging the gap between the two entities. Such a body would be in a position to alleviate legal issues in licensing by pre-negotiating and funding issues through the UNFCCC's financial mechanisms. The CTC would be in a unique position to not only determine suitable matches for technology transfer but also to drive innovation by informing technology developers of the needs of potential developing country customers.

B. National Incentives

But even if a technology is available for license, complete with know-how and a business model matched to a developing country, that country may lack the infrastructure or economic disposition necessary for implementation. For example, a wind turbine design might be licensed with all the knowledge necessary for manufacturing the turbine, but if the developing country's local power grid cannot handle the fluctuation in energy production inherent to the fluctuation of the winds themselves, the technology may be worthless. Similarly, national subsidies for fossil fuels may provide an insurmountable barrier to a moderately priced solar field. Therefore, a national level of transfer mechanisms will be required to counteract such internal barriers.

Research companies in developed countries need to coordinate with their governments in order to spur sufficient competition and keep pricing low for green technology packages. Since most clean technology research is publicly funded, submission of a green technology package for each commercialized clean technology could be a requirement to receive public funds. At the very least, countries like the United States may have to modify existing laws such as the Bayh-Dole Act, which favors licensing to firms that manufacture primarily in the United States.[107] An exception in the Bayh-Dole Act for clean technologies will benefit clean technology patent owners in the United States by permitting out-sourced labor and production to reduce the overall cost of commercialization of a technology. Given current U.S. unemployment rates, it will be politically unpopular to suggest that manufacturing jobs of clean technologies should be moved to a developing country. But developed nations like the United States would be better served focusing on jobs creation in the areas of clean technology research and development, rather than manufacturing. The United States' advantage over many other nations lies in the exportation of intellectual property knowledge, not exportation of manufactured goods.

Incentives have been successfully used in the past to spark innovation in underdeveloped technologies, or to give a competitive advantage to areas already developed. Ethanol subsidies in the U.S., and petroleum subsidies in Venezuela and Russia, are examples of ways to reduce pricing in a particular technological area. Prizes, like the X Prize for space flight, can inspire and mobilize technology innovators.[108] Public funds and grants for research and development such as the California Public Utilities Commission Solar Initiative and Sustainable Energy USA awards can help grow a technology sector.[109] Developing nations can implement similar incentives to help growth in the clean technology sectors.

In addition to incentives to develop endogenous technology, developing nations should use national incentives to encourage investment in clean technology transfer. Both positive incentives, such as prizes or subsidies, and negative incentives, such as carbon taxes, can tip the balance in favor of clean technologies. Without such monetary incentives, the gap with fossil fuels in competitive pricing will only be reduced by innovation. This will lead to long delays in the adoption of clean technologies on a large scale, while further harm is done to the environment. If a successful exchange of technology can take place, the benefits can simulate the advantages of foreign direct investment: a developing country gains improved clean technology sectors and the knowledge and skills for their own future development. In the long term, the level of competition and global market demand will increase and the developing nation can use the global IP system to strengthen its own economy.

Incentives can also be linked to the green technology packages. An incentive would help

106. United Nations Framework Convention on Climate Change, *Preparing for the Implementation of the Proposed Technology Mechanism* (Expert Group on Technology Transfer, Working Paper EGTT/2010/13, Nov. 4, 2010), *available at* http://unfccc.int/ttclear/jsp/EGTTDoc/EGTT_Modalities_draft_working_paper_4%20November.pdf. *See* United Nations Framework Convention on Climate Change, Subsidiary Body for Scientific & Technological Advice, U.N. Doc. FCCC/SBSTA/2002/L.9 (June 12, 2002) (establishing the Expert Group on Technology Transfer).

107. *See* Bayh-Dole Patent and Trademark Laws Amendment Act, Pub. L. No. 96-517, 94 Stat. 3015 (1980).

108. Kammen, *supra* note 11, at 343 (calling for a sustainable energy award in the U.S.).

109. *Id.*

subsidize the purchase of a green technology package by a developing nation or work cooperatively to provide any necessary infrastructure improvements. For example, a guaranteed update to a developing nation's local power grid might be offered to a firm licensing the technology to build a wind or solar field. Developed nations could also make public funds contingent on the formation of green technology packages. Hence, if a firm receives research dollars from the government and that research leads to patenting and commercialization, the firm could be required to offer a green technology package at a competitive price. If a developing nation desires a green technology package, the IP rights holder would still receive a royalty on the license and a public image boost for the spread of green technology.

One problem with incentives is the balance of technologies. Since incentives are designed to disturb the natural balance, care should be used in deciding which clean technologies will receive benefits. Developing nations should choose only the most efficient green technology package based on the nation's local constraints. A loss of efficiency results in waste and misplaced incentives to green technology package providers. Appropriate time limitations on subsidies would also help to ensure that the choice of technologies is flexible and to prevent dependence on a single technology.

Another issue to consider is the role of IP in light of green technology packages and national incentives. The stability and strength of an IP legal system could affect the relative pricing of a developing nation consumer. Some nations may appear riskier than others based on weak IP enforcement or unfavorable national IP laws. China, for example, has a reputation of being a risky country to invest in because of favoritism towards its citizens.[110] In China, unlike many other countries, the licensor may have no rights to any improvements made by a licensee.[111] A green technology package to China may be more expensive as a result of this favoritism. This may, in turn, encourage China to establish a more balanced IP system for foreigners.

XI. Conclusion

The most significant aspect of green technology packages is the quid pro quo – climate change adaptation and mitigation technologies in exchange for potential profits for IPR holders and innovators. The global IP regime can be used as a resource in gathering information and facilitating licensing. The international community should direct efforts toward reducing the barriers that impede these transactions and work to develop a strong clean technology market. Groups like the CTC can help identify potential developing nation consumers and pair them with clean technology providers. Governments can limit domestic barriers that impede transfer of clean technologies and incentivize development of clean technologies. Though economic conditions or political pressures may galvanize a united movement toward alternative energy solutions, appeals to nations through profit may be more effective than an appeal to a sense of the public welfare. Green technology packages and corresponding incentives can appeal to both and, therefore, make promising mechanisms for promoting environmentally sound technologies in the developing world.

110. *See* Mei Gechlik, *Making Transfer of Clean Technology Work: Lessons of the Clean Development Mechanism*, 11 San Diego Int'l L.J. 227, 263 (2009).

111. Copenhagen Economics, *supra* note 48, at §4.1.28.